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Gifts for a King

FRANKINCENSE. Myrrh. Twenty centuries have passed since these things were brought by kings as gifts for the infant King they came to worship. And throughout those twenty centuries frankincense and myrrh have retained a fascination and a beauty and mystery redolent of that first Christmas. But what are these things that they would be chosen as gifts for the Christ child? What significance could they have held? Where did they come from? How were they used?

At the beginning of the Christian era, those three Magi could scarcely have chosen gifts more universally valued, or more appropriate for their purpose. Frankincense and myrrh are fragrant gum-resins which come from trees of the same names. They are native to only two parts of the world: southern Arabia and northern Somaliland—probably due to the unique combination of moisture, temperature, and soil conditions found there.

The myrrh tree has a thick central trunk—too thick, it seems, for its four to 15 foot height. The frankincense is a shrub-like tree that lacks a central trunk and grows no taller than about nine feet. The gum-resin from both trees is tapped by cutting and peeling the bark in several places. The resin slowly exudes and, in time, hardens into lumps or "tears." It was these hardened tears which, two millennia ago, were two of the most sought-after treasures in the world.

Frankincense was used as an incense, frequently in religious services, but also in people's homes. Balls of this resin were found in the tomb of King Tutankhamen, probably intended for use in the afterlife. Frankincense was used as a sacrifice to propitiate Greek and Roman gods. It was made into cosmetics and perfumes, and was widely used as a medicine for many ailments: to stop bleeding, to heal wounds, as an antidote for poisons; for bruises, ulcerations, and paralyzed limbs.

Myrrh was also used as an incense, but less commonly than was frankincense. More important was myrrh's use in cosmetics and perfumes, and as an ingredient of a fragrant annointing oil. Like frankincense, myrrh was widely used in medicine. And perhaps most significantly, myrrh was used in embalming. Only the very wealthy and members of royalty were embalmed; hence, myrrh was a gift associated with kings.

Taken together, the uses of these two resins made these products of mideastern farmers a treasure. The agricultural workers who planted, cultivated and tapped the trees and collected the tears were the first links in many chains of camel caravans and fleets of ancient ships. These links of farmers, camels and ships connected the cities of the ancient world.

When we give our Christmas gifts this year, we do so as a vestige. It began with agricultural workers in Arabia, and with the Magi who gave the very first.—*R.W.D.*

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COVER: Spoils of strip mining in some western states have challenged SEA researchers to develop specialized land reclamation techniques. At a strip mine in Wyoming, huge earth movers build a topsoil hillock. After coal has been removed, the overburden and topsoil will be returned to their original contours, and the ground replanted (0878X938–7). Story begins on page 10.

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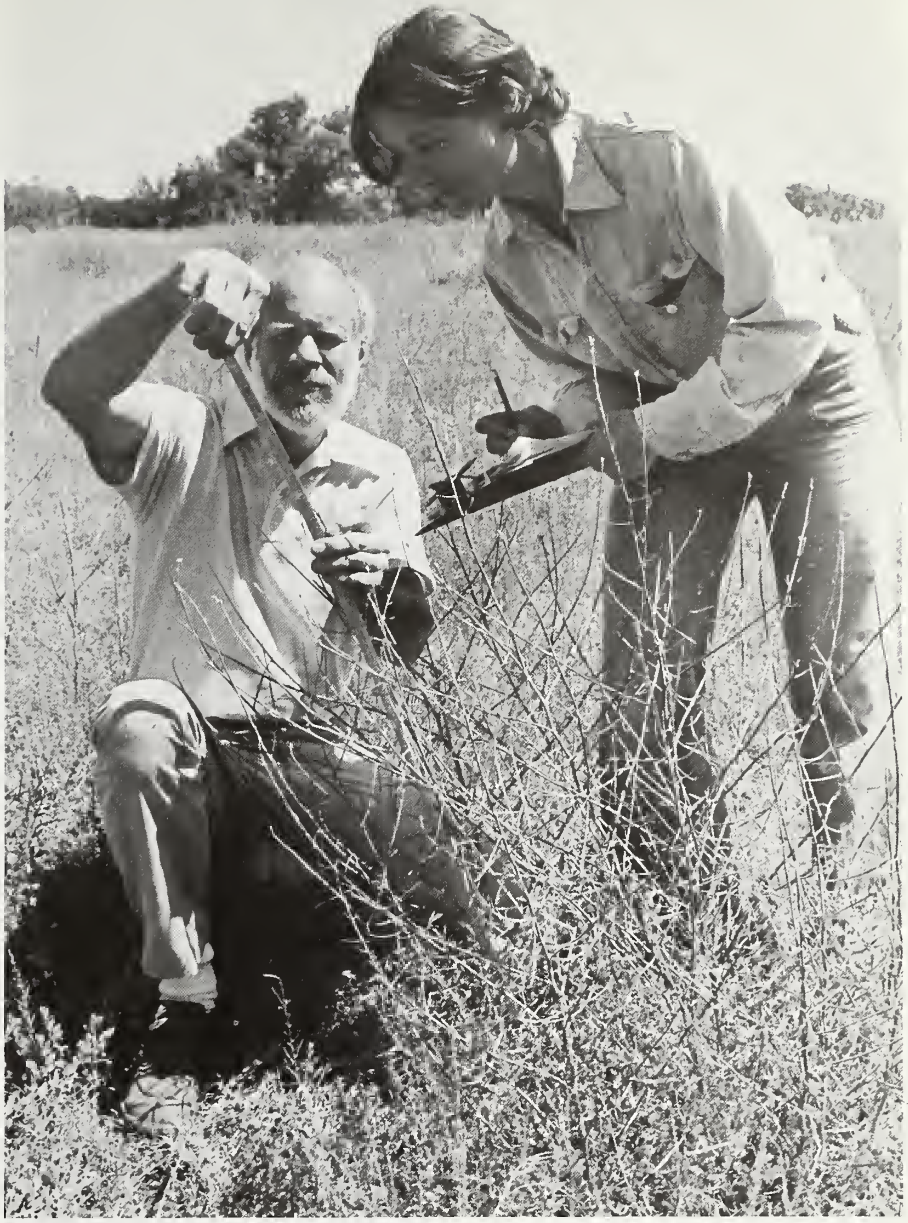


Stem height is one of the criteria used in measuring the effectiveness of certain biocontrol organisms against skeletonweed. Dr. Andres and biological laboratory technician Sally Levinson record the heights of skeletonweed plants that have been exposed to rust, insects, and mites. Reduced growth rates can demonstrate significant damage to the plants (0678X760–7).

Natural Enemies Sought for Skeletonweed

NATURAL enemies of skeletonweed, also known as rush skeletonweed, a serious threat to grainlands in western North America, are under study by SEA in a biological control effort to reduce the spread of this pest.

Skeletonweed—*Chondrilla juncea* L.—infests parts of Idaho, Washington, Oregon, and California. The Idaho and California infestations are said to be from 350,000 to 400,000 acres (140,000 to 160,000 hectares) in each state.

For years following the first appearance of skeletonweed, California was spending $100,000 a year on detection and efforts toward eradication. Unable to eradicate the plant, the State is now seeking a control and containment situation, including biological control. That is also SEA's goal.

Australia, where the weed has a stronger foothold than in the United

States, loses millions of dollars each year to the pest. The weed robs grainlands of moisture and nutrients and, in the fall, hampers mechanical harvesting equipment with its tough foliage.

"Down under," a natural enemy control program, was begun about 1970 with some success—"savings" have been estimated to be about $42 million since then. Of a total possible annual loss in that country from skeletonweed of $29 million, it has been said that some $26 million can be saved each year when the natural enemies and the plant gain equilibrium. Many Australian wheat fields, out of production because of the weed, were back into production within 2 or 3 years after the control program started.

The organisms being studied in the United States are a gall midge, a gall mite, and a plant pathogen—a rust—all specific to skeletonweed.

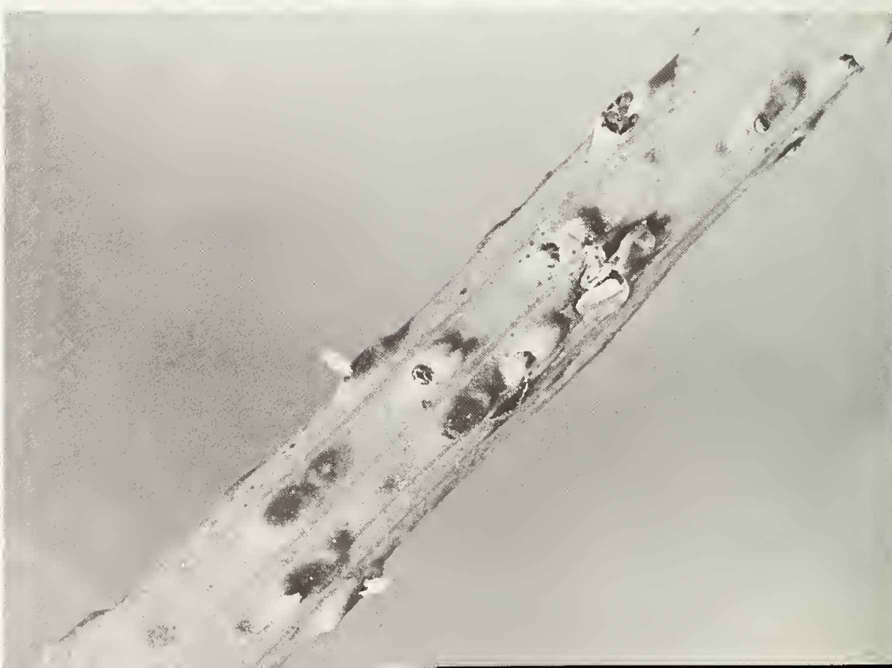
All three organisms have been researched in depth both in this country and in Australia to make certain that the only "host" attacked is skeletonweed. In fact, the gall mite and the pathogen are so specific that scientists must search for those that attack the particular varieties of skeletonweed growing in the United States.

SEA has released both the midge and the mite to the State of California Biological Control Project. Cooperative releases of both natural enemies were made in Placer County—the midge in the fall of 1975 and the mite in the fall of 1976. Both are established and spreading, but low moisture conditions in 1977 have limited buildup.

First releases of skeletonweed rust were made also in the fall of 1976 in five spots near Loomis in Placer County. It's about the same story there. No natural buildup accrued because of low moisture conditions.

When weather conditions return to normal, however, scientists believe the insects and rust will "take off" like they did in Australia where control became evident after only 1 year.

Dr. Lloyd A. Andres, entomologist at



Three kinds of damage to skeletonweed are brought about by three kinds of natural enemies: pathogen, insect, and mite. ***Far left,*** *a rust called Puccinia chondrillina spreads over a skeletonweed stem (0678X761–30A).* ***Below left,*** *midge galls rest inside the stem (0678X761–16A), and at* ***left*** *is the cancer-like deformity of flower and stem tissue caused by the feeding and development of gall mites (0678X760–33). Intense and timely attacks by these natural enemies to skeletonweed can greatly reduce stem height, seed production, and general plant vigor.*

SEA's Biological Control of Weeds Laboratory, Albany, Calif., got the midge—*Cystiphora schmidti* (Rubsaaemen)—from Australia, originally imported to that country from Greece. The midge, a flyer, lays eggs on stems and leaves of skeletonweed under the surface. The eggs develop into larvae and the larvae cause small reddish galls to form on the plant. The galls sap much of the plant's energy, causing stunting and reduced seed production. Emerging adults can travel several miles to lay eggs on surrounding skeletonweed.

Dr. Andres obtained the mite—*Aceria chondrillae* (G. Canestrini)—from Vieste, Italy. The microscopic-sized mites form galls, sometimes as large as golf balls, on the growing tips of the plant, and transfer from one skeletonweed plant to the next by being blown by the wind much like pollen.

Rust research is being done by Dr. Robert G. Emge, plant pathologist at SEA's Plant Disease Research Laboratory, Frederick, Md.

"If biological control of this weed is successful in California, the threat of this pest spreading to other states will be reduced as well," Dr. Andres says.

Meantime, SEA scientists are looking for other natural enemies of the weed in its native habitat that ranges from southern Russia to north Africa and from France and Portugal to Turkey and Iran.

The plant was first seen in this country in the East in 1870 and is sparsely distributed there even today. There, it is not considered a pest. Skeletonweed was first seen in Idaho and California in the 1900's and was probably introduced with orchard and vineyard rootstocks.

Dr. Lloyd A. Andres is with the Biological Control of Weeds Laboratory, University of California, Gill Tract, 1050 San Pablo Avenue, Albany, CA 94706.—*J.P.D.*

Controlling Grasshopper Plagues

IN THE wake of world-wide grasshopper plagues this past summer, SEA researchers at the Rangeland Insect Laboratory, Bozeman, Mont., have stepped up their search for safe, economical and quick grasshopper control methods. Two approaches to this problem look promising.

Both approaches spring from original work done by the researchers on *Nosema locustae*, a deadly natural disease of grasshoppers and crickets (AGR. RES., January 1976, p. 5). The researchers have already controlled several severe grasshopper and cricket outbreaks by spraying *Nosema locustae* spores on wheat bran, and then dropping the wheat bran into the infested area.

The insects eat the infected bran, contract the disease, and die. Other hoppers or crickets eat the cadavers of their comrades, contract the disease and also die. The disease affects only grasshoppers and mormon crickets and poses no threat to people, plants or animals. Unfortunately, *Nosema locustae* needs about 2 weeks to take effect. A speedier control method is needed.

There are two other grasshopper pathogens, similar to *Nosema locustae*, but which work faster—*Nosema acridophagus* and *Nosema cuneatum*. The problem in developing these two pathogens as control methods has been finding a way to mass produce their spores in sufficient quantities for field testing.

Nosema locustae spores are produced in laboratory-reared grasshoppers — one infected grasshopper will provide enough spores to treat two acres of infested land. But *Nosema acridophagus* and *cuneatum* kill infected grasshoppers too quickly for enough spores to be produced.

Led by SEA entomologists John E. Henry and Jerome A. Onsager, the research team at Bozeman has found that the corn earworm—a notorious pest in its own right—can serve under laboratory conditions as an alternative host for the other two *Nosema* pathogens and produce more than enough disease spores for field testing.

Corn earworms are cheaper and easier to rear in a laboratory than grasshoppers and disease spores multiply faster in earworms. Corn earworms are inoculated at 4- to 6-day-old larvae. The larvae are starved for a 24-hour period to upset their metabolism so that when they do eat, everything consumed will be absorbed.

A drop of distilled water containing 10^5 to 10^6 disease spores is fed to the larvae and they are then starved in a second 24-hour period so that nothing interferes with their contracting the disease. At the end of this second starvation period, the corn earworms are placed in individual growth chambers. The spores multiply in the larvae until the disease kills the host—usually 2 to 3 weeks later.

Corn earworms can only be infected under laboratory conditions and only with *Nosema acridophagus* and *cuneatum*, not *locustae*. Right now, the

process of inoculating earworms is time consuming and inefficient. The research team is working to correct this.

Until the two "hotter" *Nosema* pathogens are field-tested and developed, *Nosema locustae* remains our best biological weapon against grasshopper plagues. The Rangeland Insect Laboratory team has found that the time required to bring an outbreak under control can be considerably hastened by using *Nosema locustae* in combination with a small amount of pesticide.

The pesticides used most extensively today to control grasshoppers are malathion and carbaryl. By using these pesticides with *Nosema locustae,* normal doseages of the chemical insecticides could be reduced by 98 percent, and chemical treatment costs could be cut by 70 percent.

Malathion or carbaryl-treated bran is added to some of the *Nosema locustae*-treated bran and all of it is then air dropped over an infested area. Grasshoppers eating the chemical-treated bran die instantly and the infestation is immediately reduced. The *Nosema locustae*-treated bran then keeps the insect populations under control.

Combined use of *Nosema locustae* and malathion or carbaryl provides both short-term and long-term control of grasshoppers. The insecticides are applied only to a portion of the treated wheat bran and are therefore more selective than treatments applied as a general broadcast application.

The idea behind all of the control methods being studied by the SEA researchers is to reduce rangeland grasshopper populations to levels the environment can tolerate. When hopper populations become too dense the insects migrate and cause great damage to crops.

Dr. John E. Henry and Dr. Jerome A. Onsager and the rest of this SEA research team are located at the Rangeland Insect Laboratory, Montana State University, South 11th Avenue, Bozeman, MT 59717.—*L.C.Y.*

Cattle Egg Factories

Cows that serve as egg factories, producing eggs destined to be transferred as embryos to other cows, are not the fantasy creatures of an Aldous Huxley; they exist today and SEA researchers are working to give them a prominent role in the beef industry.

The demand for beef is great. Beef cattle are the single largest income-producing commodity in the United States—last year generating over $27 billion in income compared with the less than $6 billion generated by wheat. The demand continues to climb; however, cattle numbers are falling.

One of the major problems in increasing cattle numbers is the inability of most beef cows to produce more than one egg (hence, no more than one possible calf) a year. Experimental hormone treatments are being used to stimulate greater egg production, but the response of cows to such stimulants is unpredictable.

With hormonal aid, some cows can produce a great number of eggs, though production of more than 2 or 3 eggs usually results in mass embryonic death and loss of pregnancy. SEA researchers at the Livestock and Range Research Station, Miles City, Mont., in cooperation with the University of Wisconsin, seem well on their way to solving this dilemma.

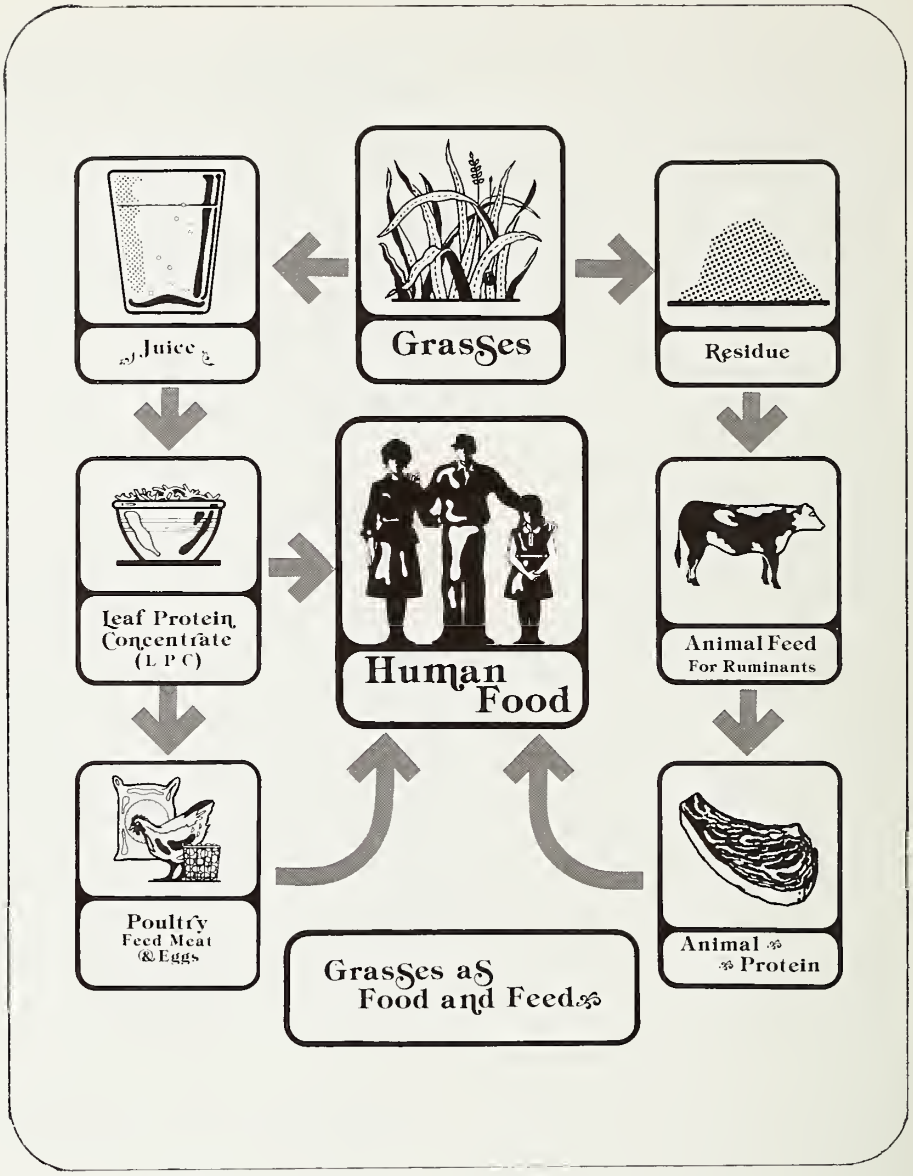
The researchers are developing a non-surgical technique where an egg can be transferred from the uterus of one cow into the uterus of another. If the technique is perfected, select cows that respond well to hormone treatments could serve as ovum banks, creating eggs with highly desirable genetic traits, much as select bulls serve as sperm banks. Cows of lesser value could then be recipients for highly select eggs fertilized with semen from genetically superior bulls.

The technique behind the embryo transfer requires patience and care to execute but is not complex. An egg is removed from the reproductive tract of a donor cow 8 days after estrus. Earlier than that, the egg is too difficult to obtain and later it is too fragile to be moved.

The egg is removed by placing a sterile fluid into the donor cow's uterus. The egg floats in the fluid which is aspirated out of the uterus. The egg is examined microscopically to determine if it is normal. It then is placed in an inseminating straw and deposited in the recipient cow just as sperm might be.

Embryo transfers won't have the impact on the industry that storing frozen semen will—a good donor cow might produce over 100 calves in her lifetime while thousands of offspring could potentially be obtained from a single donor bull. But embryo transfers will make multiple calf-producing cows out of selected animals and the calves that are produced should be good ones.

SEA researchers on this project are animal physiologists Dr. Robert A. Bellows, Dr. Robert E. Short, and Dr. Robert B. Staigmiller. All are located at the Livestock and Range Research Station, Route 1, Box 3, Miles City, MT 59301.—*L.C.Y.*



Grasses as food and feed, a natural renewable protein source. Grasses have always been thought to be a source of feed for animals. The use of grasses as food for humans adds a new dimension to the solution of world food problems (PN–4171).

High Protein Foods From Grass

PAKISTANI scientists have recently developed high protein foods from a grass extract, called leaf protein concentrate (LPC).

SEA research chemist John J. Evans, Athens, Ga., is the cooperating scientist for this Public Law 480 project. "Twenty species of grasses of common interest to the United States and Pakistan were studied for their yield, content and extractability of protein. The Pakistani work supplements current SEA laboratory tests at Athens to develop high protein poultry feeds using southern forages such as Coastal bermudagrass," says Dr. Evans.

The Pakistanis used the following procedure for extracting protein from the grasses: first, pulping and pressing the leaves to obtain a juice concentrate which was steamed at 80° C. (176° F.). A coagulated LPC and a liquid filtrate were extracted from the juice. The LPC, which consisted of protein, lipids, carbohydrates, minerals, vitamins, and provitamins was used for both feed and food.

The filtrate, or liquid left after coagulation of LPC, was nutritionally rich enough for the propagation of microbial foods such as yeast and mushrooms.

The residue left after extraction of the juice filtrate contained protein, fiber, lipids, lipid soluble vitamins, and carbohydrates and was found suitable for ruminant feed.

Two examples of traditional Pakistani foods which were fortified are a bread and potato sandwich, and Chutney (a popular far eastern sauce). The sandwich, which contains bread, boiled potatoes, butter, cumin seeds, salt, chilies, and pepper was fortified with seven grams of LPC, creating a protein increase of 51.3 percent.

By adding 15 grams of LPC to 100 grams of Chutney—a sauce made with mint, coriander, onions, pomegranate seeds, and red chilies — the scientists were able to increase its protein content by 70.2 percent. The Pakistanis showed that LPC incorporated in their native dishes does not affect taste, texture, or flavor.

"Unfortunately," Dr. Evans says, "LPC is green in color, and this may result in a slight discoloration of some food products which would not be esthetically acceptable in most Western countries. On the other hand, this is not a problem in the East where many food delicacies are green.

"However," he says, "the Pakistani work has provided SEA researchers with needed information on the preparation, composition, and use of leaf protein concentrates. If SEA scientists can economically develop a white, edible protein concentrate from grass, we will have an important new source of protein for food fortification."

This project was conducted under the direction of Dr. Farrukh Hassan Shah at the Pakistan Council of Scientific and Industrial Research Laboratories, Lahore, Pakistan. Dr. John J. Evans is with the Field Crops Research Laboratory, Russell Research Center, P.O. Box 5677, Athens, GA 30604.—*M.C.G.*

Yellow Nutsedge Curbed by Preplant Herbicide

Corn losses caused by yellow nutsedge can be prevented by working one herbicide into the soil before planting. But at least two assaults against the weed are needed each year for 2 or 3 years to reduce populations of nutsedge tubers in the soil.

These findings came from a joint study by the Science and Education Administration and the University of Illinois at Urbana on a silty clay loam soil that had been heavily infested with yellow nutsedge for several years.

Yellow nutsedge abounds on more than 2 million acres (800,000 hectares) of the American Midwest and is one of the world's most serious weeds infesting cultivated lands. It produces seeds but propogates mainly from tubers, basal bulbs and a complex of underground stems, called rhizomes. During the winter the bulbs and rhizomes die, but the tubers survive to produce shoots during the subsequent growing seasons.

SEA plant physiologist Edward W. Stoller and his colleages found that yield reductions vary greatly from year to year, but on the average each 100 nutsedge plants per square meter cut corn yields by about 8 percent. Corn yields on some of the plots used in a 3-year study were reduced by as much as 50 percent. Even greater losses can occur on lighter soils where there is less moisture for corn and weeds, the agricultural research scientist says.

If yellow nutsedge is not controlled at planting time, applying herbicides later or cultivating will not prevent a yield reduction, Dr. Stoller says. He bases this statement on two additional 3-year studies that the federal and state teams conducted.

In those studies the scientist compared 12 combinations of weed control measures and 6 single measures with no weed control. The control measures included the use of various herbicides, cultivation, and hand weeding. Corn on hand-weeded plots produced yields that were no higher than yields on some of the plots where at least one control measure was herbicide that had been worked into the soil before planting.

Dr. Stoller says the research also shows that season-long control measures must be obtained at least 2 years to reduce tuber numbers significantly. At the end of the first year, for example, the researchers found that the number of tubers in hand-weeded plots did not differ greatly from most of the tuber populations where up to three control measures were used. At the end of the third year, however, hand-weeded plots had 20 tubers per square meter in contrast to 400 tubers where cultivation was the only control measure.

Participating in the study with Dr. Stoller were SEA agronomist Dr. Loyd M. Wax and University of Illinois agronomist Dr. Fred W. Slife.

Dr. Edward W. Stoller's address is USDA–SEA, Room 215 Davenport Hall, University of Illinois, Urbana, IL 61801.—*G.B.H.*

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Strip Mining Without Ha

Above: At the Energy Fuels Mine near Steamboat Springs, Colo., SEA range scientist William McGinnies and graduate research assistant Paula Nicholas evaluate mid-summer growth of several grass species planted on reclaimed land (0778X905–18A).

STRIP mining need not mean ecological disaster to the environment. With proper reclamation efforts, strip mined land can be restored and possibly even be improved.

Coal is currently being looked upon to play a more important role in making this country less dependent on foreign sources of energy. According to the U.S. Bureau of Mines U.S. coal deposits contain over 2½ times as much energy as is available from the entire world's known oil supply.

Of the estimated 137 billion tons of strippable coal, over 69 percent of it lies in the western States and in Alaska, according to the latest estimates by the U.S. Geological Survey. Most western coal is low in sulfur and lies horizon-

rming the Environment

tally in seams up to 100 feet thick, and extending over areas as large as 6 by 100 miles (9.6 by 160 kilometers).

Unlike coal in the East, much of the western coal lies relatively close to the surface, making strip mining the most economical method for removal.

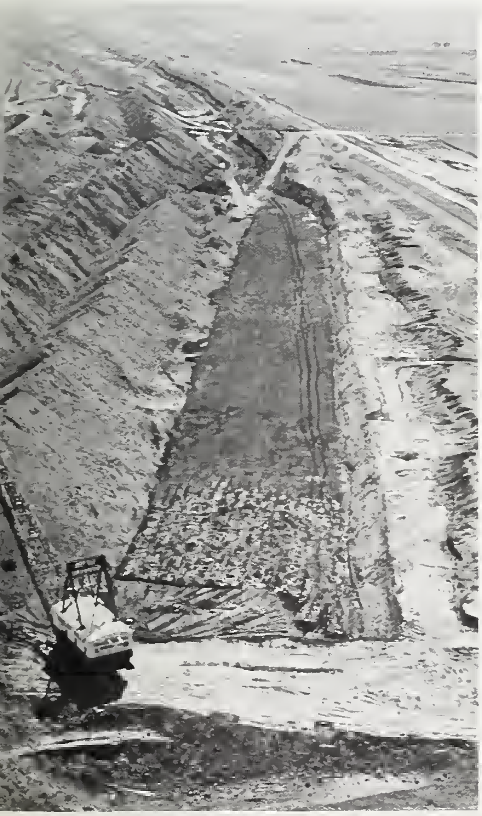
A modern strip mining operation first involves removing and storing topsoil and subsoil. The rest of the overburden (earth and rock above the coal) is removed and placed in spoil piles. After coal has been removed, the spoil is returned and graded to the premined contour. Subsoil and topsoil are placed over it. Fertilizing, reseeding and replanting is the last step.

This sounds simple, but many complex factors affect the success of reclamation efforts, such as climatic conditions, soil type, water movement within the soil and subsoil, and seeding methods and rates. Additional complications arise because all these factors can vary tremendously from one mine site to another, even if they are only a few miles apart.

Through numerous joint research projects between USDA's SEA, Soil Conservation Service, and Forest Service, the U.S. Department of the Interior, State Universities, the Environmental Protection Agency, and the mining industry, many problems associated with reclamation are being solved.

Water quality and quantity can be major limiting factors for productivity of any land area. These factors become extremely important when land is disturbed because little is known about effects of strip mining on the hydrology of the area.

SEA hydraulic engineers David A. Woolhiser and Roger E. Smith have installed measuring equipment near Steamboat Springs, Colo., to record data from both mined and unmined sites. Differences between the sites will indicate effects of strip mining. The research involved in this project will attempt to determine: distribution of precipitation, movement of water and salts in the plant root zone as affected by vegetation and replacement of overburden and topsoil, effects of surface treatments such as terracing on erosion and water quality, and transport and



Center: *Typical of stripmines on the Northern Great Plains is the Knife River Coal Company's South Beulah Mine, at Beulah, N. Dak. The five "windrows" on the left are overburden removed by dragline to reveal the coal seam on right. Overburden and topsoil will be replaced after coal has been extracted (0878X941-20).*

Left: *Deficiency of plant-available nitrogen often limits revegetation of disturbed lands. To monitor nitrogen cycling in the soil-plant ecosystem, 40 cylinders (each extending six feet into the ground) were installed throughout the test area. Leachate, being pumped from the bottom of the outer cylinder by soil scientist Jean Reeder, will be analyzed at the lab along with soil and plants removed from the smaller, inner cylinders. Data collected over a 3- to 4-year period will enable scientists to develop long term fertility management practices for disturbed lands (0778X 902-15).*

Below: Dr. Power inspects a test plot planted with 36 species of adapted perennials (sweet clover and several grasses). This experiment, near the Glenharold mine, is being conducted on integrated and leveled spoils covered with 6 inches of topsoil (0878X950–16).

Above: *Tensionmeters installed on test plots at the Glenharold Mine, Stanton, ND, reveal possibilities for water movement through soil placed over sodic spoils. Data from these and other instruments will be used to verify theoretical calculations of water and salt movement, enabling researchers to better select soil treatments under various mine spoil conditions. Dr. Power (left) and soil physicist Stephen Merrill discuss findings (0878X946–35).*

Left: *At the Indian Head Mine, Zap, ND, researchers have installed a series of wedge plots on sodic spoils overlayed with 0 to 4 feet of low, medium, and high quality subsoils covered with 6 inches of topsoil. The plots are seeded to alfalfa, springwheat, crested wheatgrass, and Russian wildrye (0878X939–26).*

interactions of chemicals in water.

"We will use our data with appropriate hydrologic models of postmining water balance and movement to design methods which will insure that mining and subsequent reclamation doesn't lower the quality of our rivers, lakes and streams," says Woolhiser.

This data, along with other data currently being collected, may eventually result in computer models which would enable scientists to feed field data into a computer and receive information on how to best return disturbed lands to maximum productivity.

To determine methods and plant species most beneficial in revegetating mined areas, SEA range scientists William J. McGinnies and Paula Nicholas evaluated field plots established by the Bureau of Land Management on reclaimed land near Steamboat Springs. They are now studying the effects of 18, 12, 8, 4, and 0 inches of topsoil over spoil to determine minimum amounts needed for successful plant growth.

Another experiment will show if segregation of topsoil layers (the A and B horizons) into separate piles as they are removed is needed or whether they can be removed and mixed together. Mixing the topsoil layers would be easier and less costly.

Other data they are collecting include: effect of drilled versus broadcast seeding; effect of gouging soil surface in an attempt to retain more moisture than on ungouged seedbeds; and hardiness and adaptability of grasses, forbs and shrubs using these various treatments.

Total nitrogen (N) in some strip mine spoils is nearly equal to that in nearby undisturbed soils. In spoils, however, the amount of N in a form that plants can use is much less than that in unmined soils. Because little information is available on how N cycles in spoils or changes from unavailable to available forms, SEA soil scientist Jean Reeder initiated studies near the Steamboat Springs mines to determine long-term mineralization rates of N. Results of these studies will help in determining the best reclamation practices to insure that revegetation will be maintained permanently and not just while commercial N fertilizer is being applied.

Above: At the Pathfinder Mine Corporation's Shirley Basin mine, researchers have constructed test plots guarded by 18-inch soil ridges that act as snow fences to increase soil moisture storage for higher forage production. The experiment is sited on spoils of White River overburden covered by 6 inches of topsoil, and planted to crested wheatgrass and four-winged saltbush. Pathfinder mine biologist Thomas Hinton accompanies soil scientist Gerald E. Schuman and horticulturist Gene S. Howard of SEA on a survey of early summer growth during the experiment's second season (0878X936–9).

One of the major obstacles to revegetation on disturbed lands in Wyoming is limited precipitation. Most mine sites near Shirley Basin and Gillette receive only 12 to 14 inches of precipitation per year. Some of this is in the form of snow that falls when plants are dormant and blows away to collect in drifts. When these drifts melt in spring, the water, largely unused by revegetation plants, often causes erosion on its course to downslope streams and rivers.

At several mine sites in Wyoming, SEA soil scientists Gerald E. Schuman and Frank Rauzi are studying soil surface treatments that trap snow for uniform distribution and later plant utilization. Ridges, tall grass barriers, pits and furrows (which act as miniature

snow fences), hold snow in place until warmer weather arrives to melt the snow for storage in the soil and subsequent plant use. An even blanket of snow, rather than drifts, also acts as insulation for delicate seedlings.

Other data they are collecting include: use of grass stubble for mulching versus crimped residue; fertilizer management of reclaimed land; and topsoil depth requirements.

"Of 83 native and introduced woody plant species now under test at mine sites in Wyoming, mugwort wormwood, or *Artemisia vulgaris*, looks promising for possible use in revegetation. This herbaceous sage, native to Eurasia, survives the harsh climate well, can be started from seed, and has an average 31 percent protein content and 67 percent digestibility," says SEA horticulturist Gene S. Howard. Several other woody species that have thorns or other protective mechanisms to limit wildlife browse also look promising.

Another area of strip mining activity, western North Dakota, has spoils high in sodium. This chemical element migrates upward into the replaced topsoil on reclaimed lands, reducing productivity of the land and vegetative yields. Scientists stationed at the Northern Great Plains Research Station, Mandan, are exploring ways to keep sodium below root zones.

"Treatments for reclaiming high-sodium spoils may cost several thousand dollars. This may appear expensive, but not when one considers this represents only pennies per ton of coal that was removed," says SEA soil scientist James F. Power.

Other research at Mandan includes projects on several of the problems being investigated in Colorado and Wyoming, plus studies on the effects of animal grazing on revegetated areas, use of different water qualities and quantities for irrigation and fertilization requirements.

"Our reclamation projects are closely aligned with regulations recently enacted by Congress," says C. E. Evans, SEA Area Director for Colorado and Wyoming. "By applying our present and future research discoveries, we hope to recreate an environment that is both esthetically pleasing and supportive of livestock and wildlife. Our goal is not merely to restore lands to present productivity but to improve them whenever possible."

These scientists can be contacted through the Colorado/Wyoming Area Office, Federal Building, P.O. Box E, Fort Collins, CO 80522.—*D.H.S.*

***Left:** On trial: Eighty-seven species of woody shrubs and forbs are undergoing selection testing for adaptability to various soil conditions of the stripmines and the rigors of Wyoming weather. Inspecting shrub growth with Mr. Howard, who is conducting the tests, is cooperating SCS agronomist Lon Young (right) (0878X935-35A).*

***Below:** Dr. Schuman inspects dramatic gains in forage growth on fertilized overburden leveled before saving and replacement of topsoil was required. Without special fertility management this overburden at the Shirley Basin mine could not sustain adequate vegetative cover—as demonstrated by the unfertilized control plot in background. Further experiments will determine required fertilizer management practices for other stripmines reclaimed before present laws came into effect (0878X934-26).*

Potato Bins Need Ventilation

Newly harvested potatoes can become seriously diseased or lose water in excessive amounts if the storage bins are not ventilated properly. SEA researchers conducted a 3-year study that shows how much ventilation is normally needed.

Results of the study at the Red River Valley Potato Research Laboratory, East Grand Forks, Minn., are applicable to commercial size bins that may hold 1 million pounds (454,000 kilograms) of potatoes or more.

Agricultural engineer Lewis A. Schaper says. "We found that closed dampers in the bin and 2 to 4 hours of fan ventilation per night was suitable during suberization," a critical process in which potato skins thicken during the first week or two of storage. This process reduced extensive moisture and weight loss from the potatoes during the rest of the storage period.

Biochemist Jerry L. Varns who also participated in the study says that ventilation of bins to keep carbon dioxide concentrations generally below 3 percent should enhance suberization and the healing of wounds that are inflicted on potatoes during harvesting and storing. The federal researchers also found that many of the potatoes developed soft rot in an unventilated bin having higher levels of carbon dioxide.

Other researchers have shown that high carbon dioxide levels stimulate bacterial dry rot and several fungal diseases.

If potatoes going into storage are known to have a soft rot problem, more than 4 hours of ventilation per night may be needed, says Schaper. Normally, however, such potatoes should not be held in long-term storage. Bins for storing potatoes that are to be processed range in volume from 20,000 to 220,000 cubic feet. These bins hold enough potatoes to feed 6,700 to 74,000 people annually; however, as much as 20 percent of the stored potatoes may be lost to disease and mismanagement in extended storage.

Because the value of potatoes in these commercial-size bins is so large and the potential loss so great, federal researchers use computerized mathematical models to represent storage in large bins. Models enable them to determine relationships of physical environment and physiology of potatoes during long-term storage. Temperature, humidity, air circulation and the respiring potatoes' production of carbon dioxide are measured in the research.

The scientists are developing models which range from about 1½ cubic feet to 35,000 cubic feet (0.045 to 1,050 cubic meters). The concept of modeling greatly speeds up research needed for determining conditions which affect the storage life of potatoes.

Schaper says the ideal amounts of ventilation time also vary with the design of bins and ventilation systems, potato varieties, maturity of the potatoes at harvest, chemical treatments of the potatoes, and storage temperatures.

The researchers conducted the study cooperatively with the Minnesota and North Dakota agricultural experiment stations and the Red River Valley Potato Growers' Association.

Mr. Lewis A. Schaper's and Dr. Jerry L. Varns' address is USDA–SEA, Red River Valley Potato Research Laboratory, P.O. Box 113, East Grand Forks, MN 56721.—*G.B.H.*

New Sunflower Pest

A new pest of sunflower has been caught in the act.

A scarab beetle (*Phyllophaga lanceolata*) devastated more than a thousand acres (400 hectares) of sunflower near the town of Lehman in west Texas.

According to SEA research entomologist Charlie E. Rogers and Dr. William P. Morrison, entomologist with Texas A&M University in Lubbock, this attack by the beetle is the first record of it as a pest of commercial sunflower.

"The adults of this beetle completely destroyed 1061.1 acres (430 hectares) of sunflower planted on converted grassland pasture," says Dr. Rogers. "The field has been in rangeland pasture for several years before it was cultivated and planted to sunflower. The only plants left were a narrow strip of partially standing seedlings along one margin of the field."

The scientists went on to point out that sunflower is a relatively new crop in the Texas southern plains, and problems with new insect pests are likely for the next few years.

Dr. Charlie E. Rogers is located at the Southwestern Great Plains Research Center, Bushland, TX 79012.—*B.D.C.*

Firming Up the Freestone

RECOGNITION of the relative levels of enzymes in freestone peaches compared with those of clingstone peaches may "open a door and give fruit breeders a chance," says scientists at SEA's Russell Research Center.

The freestone peach—seen by consumers as "ragged" when it comes out of the can—softens more than the clingstone peach. This softening problem is related to the "melting" characteristics of peach flesh. Freestones are characterized by a melting type flesh while clingstones are frequently nonmelting. The freestone is, in fact, very difficult to process.

If breeders could develop a freestone peach that would retain its firmness, processing problems might be solved.

Above: Dr. Pressey uses a pressure tester to measure the flesh firmness of freestone peaches, while physical science technician Jimmy Avants homogenizes a peach for subsequent enzyme separation (0878X1157–17).

Chemist Russell Pressey studied the enzymatic differences between the two peaches with the ultimate goal of manipulating postharvest ripening changes, using bioregulators.

The difference in texture may be due to more degradation of pectin in freestone than in clingstone fruit. Pectin is an important structural polysaccharide in the cell walls of fruit tissues. The enzyme involved in pectin degradation is polygalacturonase.

"There are two basic polygalacturonase enzymes," says Dr. Pressey. "Endo- and exo-polygalacturonase. We have examined the fruit of each of six varieties of clingstone and freestone peaches to compare the levels of these enzymes.

"At the unripe stage, all varieties of both types of peaches had low levels of water-soluble pectin and virtually no polygalacturonase activity. But in ripe freestone peaches, there were high levels of soluble pectin and both endo- and exo-polygalacturonase. In the clingstone peach only exo-polygalacturonase is present."

Dr. Pressey and physical science technician J. K. Avants found that the endo-polygalacturonase is much more effective in degrading pectin than the exo-polygalacturonase.

Their conclusion: If pectin is the critical component in peach softening, the difference in enzyme composition accounts for the difference in softening characteristics.

Dr. Russell Pressey is with the Horticultural Corps Laboratory, Russell Research Center, Box 5677, Athens, GA 30604.—*P.L.G.*

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